

REMARKS

Claims 3, 4, 19-21, 27, 28 and 42 have been amended. New claim 49 has been added. Claims 1, 2, 8-18 and 30-41 have been canceled. Claims 3-4, 6, 19-29, 42, 43 and 45-49 are currently pending in this application. Applicants reserve the right to pursue the original and other claims in this and other applications. Applicants respectfully request reconsideration in light of the above amendments and the following remarks.

Applicants note that upon allowance of claims 3 and 42, at least claims 5 and 7; and 44 which depend from claims 3 and 42, respectively, and any other claims which require all of the limitations of any allowed claim, should be rejoined and fully examined for patentability in accordance with 37 C.F.R. § 1.104. M.P.E.P. § 821.04(a).

Claims 3, 6, 19, 20, 23-29, 42, 43, 45, 46 and 48 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kim et al. (U.S. Patent No. 6,731,335) ("Kim") in view of Beiley et al. (U.S. Patent No. 6,522,357) ("Beiley"). This rejection is respectfully traversed and reconsideration is respectfully requested.

The Office Action characterizes claims 3 and 6 as "method claims corresponding to apparatus claims 19 and 20" and accordingly rejects claims 3 and 6 on the same basis as claims 19 and 20. Office Action, pg. 5. Accordingly, Applicants' discussion focuses on the language of claim 19.

Claim 19 is drawn to a pixel circuit for use in an imaging device comprising a "plurality of photosensors...", a "plurality of shutter transistors, each shutter transistor connected to and transferring charge from a respective photosensor," a "plurality of storage nodes," a "plurality of transfer transistors, each transfer transistor connected to and transferring charge from a respective storage node," a "floating diffusion node connected to said plurality of transfer transistors for receiving charge from said transfer transistors," and a "readout circuit connected to said floating diffusion node to output charge accumulated at the floating diffusion node." Further, "each storage

node comprises a capacitor which is coupled to a respective shutter transistor via a shutter line and wherein each node stores charge transferred by a respective one of said plurality of photosensors.”

As can be seen in FIG. 3 (reproduced below for convenience), the claimed invention incorporates a storage node 410/426 located between the photodiode 401/402 and the floating diffusion (readout) node 430 (and in addition to the typical readout circuitry). A capacitor 408/420 is included that couples the storage node 410/426 to the global storage signal. Further, shutter gate transistor 404/416 is connected to storage capacitor 408/420 via shutter lines 405/425 (see, FIG. 10).

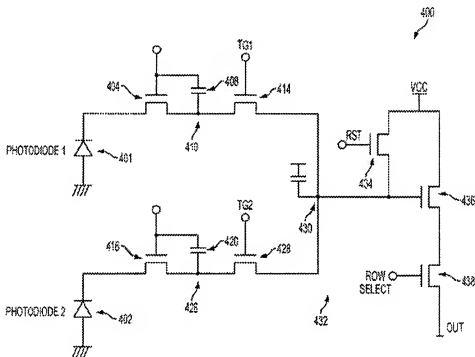


FIG. 3

This arrangement is important to the claimed invention. By storing the charge transferred from the photodiode in the storage node, the floating diffusion region is able to be reset at the same time the image is captured. See, Specification, ¶[0031]. This configuration (including the capacitor in the claimed location) also increases the capacity of the storage node. See, Specification, ¶[0030]. Additionally, tying the storage capacitor to the shutter gate transistor drives the storage node to a

high potential when transferring charge from the photodiode to the storage node; reducing the voltage on the storage node allows charge transfer from the storage node to the floating diffusion node. See, Specification, ¶[0027].

As admitted by the Office Action, Kim does not disclose a plurality of shutter transistors and storage nodes, the shutter transistors being connected to and transferring charge from a respective photosensor to a respective storage node. Office Action, pg. 5. The Office Action relies on Bailey to “teach an electronic shutter can be achieved in a CMOS image sensor by using a shutter transistor and a storage node.” Office Action, pg. 3.

Applicants note however, that Bailey does not disclose, teach or suggest that “each storage node comprises a capacitor which is coupled to a respective shutter transistor via a shutter line and wherein each node stores charge transferred by a respective one of said plurality of photosensors,” as recited in claim 19. Bailey further does not disclose that the capacitor is connected between a gate of the shutter transistor and the storage node and that the storage node and shutter transistor are also connected, as required by claims 3, 27, 42 and 49.

In Bailey, the so-called storage node actually acts as a floating diffusion node and that the pass transistor is more like the transfer transistor of the claimed invention than it is like the shutter transistor. In other words, the storage node of Bailey is not in addition to the readout circuitry, but is a part of it. Additionally, Bailey does not have a storage node between the photodiode and the readout node; Bailey merely has a photodiode and a readout node, acting to store charge. See, Bailey, col. 3, lines 22-27. Bailey does not disclose adding an additional shutter transistor and storage node to an already complete pixel circuitry. Even if Bailey and Kim were properly combinable (which Applicants do not concede), one skilled in the art would be, at most, motivated to add a storage capacitor (such as capacitor 34 of Bailey) to the circuit of Kim. The transfer transistor M43 of Kim already performs the function of the pass transistor M2 of Bailey. See, Kim, col. 5, lines 4-8 (“transfer transistor M43 ... transfers the photoelectric charges generated in the photodiode ... to the single sensing node”); Bailey, col. 3, lines 22-26 (“Transistor M2 is commonly known as a pass transistor that ... transfers the signal at node 1 (... diode node) to node 2

(... storage node)"). Therefore, while one skilled in the art may possibly be motivated to add the capacitor 34 of Bailey to the circuit of Kim, they would not be motivated to add the transistor M2 of Bailey as a second transistor, since the functionality of this transistor (transferring the charge from the photodiode to the node where it is to be stored before readout) is already performed by the transistor M43 of Kim.

Additionally, even if the pass transistor of Bailey did disclose a shutter transistor as in the claimed invention (which Applicants do not concede), the capacitor of Bailey is not located between the pass transistor and the storage node, and more specifically, it is not connected to a gate portion of the pass transistor. See, Bailey, FIG. 1.

Accordingly, Applicants respectfully submit that claim 19 is not obvious in view of the cited combination for at least these reasons. Claims 3, 27 and 42 contain limitations similar to those of claim 19 and are allowable over the cited combination for at least the reasons mentioned above with respect to claim 19 and on their own merits. Claim 6 depends from claim 3 and is allowable along with claim 3. Claims 20 and 23-26 depend from claim 19 and are allowable along with claim 19. Claims 28 and 29 depend from claim 27 and are allowable along with claims 27. Claims 43, 45, 46 and 48 depend from claim 42 and are allowable along with claim 42. Applicants respectfully request that the rejection of claims 3, 6, 19, 20, 23-29, 42, 43, 45, 46 and 48 be withdrawn and the claims allowed.

Claims 4 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kim in view of Bailey and further in view of Merrill (U.S. Patent No. 6,697,114) ("Merrill"). This rejection is respectfully traversed and reconsideration is respectfully requested.

Claims 4 and 21 depend from claims 3 and 19, respectively, which are allowable over Kim in view of Bailey for at least the reasons discussed above. Merrill is relied upon as disclosing that the storage capacitors are formed above the substrate (Office Action, page 10), and does not remedy the deficiencies of the Kim/Bailey combination as to claims 3 and 19. Accordingly, claims

3 and 19, along with claims 4 and 21, are allowable over the cited combination. Applicants respectfully request that the rejection of claims 4 and 21 be withdrawn and the claims allowed.

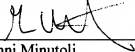
Applicants gratefully acknowledge the Examiner's statement that claims 22 and 47 would be allowable if rewritten in independent form. However, in view of the arguments advanced above, Applicants believe the claims to be allowable in their current dependent form. Applicants respectfully request that the objection be withdrawn and the claims allowed.

New claim 49 depends from claim 19 and is allowable along with claim 19. Applicants respectfully request allowance of claim 49.

In view of the above, Applicants believe the pending application is in condition for allowance.

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Respectfully submitted,

By 
Gianni Minutoli

Registration No.: 41,198

Jennifer M. McCue

Registration No.: 55,440

DICKSTEIN SHAPIRO LLP

1825 Eye Street, NW

Washington, DC 20006-5403

(202) 420-2200

Attorneys for Applicants